New Mineral Names*†

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This New Mineral Names has entries for 11 new minerals, including cesiodymite, cryptochalcite, fedosiyite, fluoro-tremolite, itelmenite, ozerovaite, ramazoite, redcanyonite, selivanovite, vanderheydenite, and wrightite.

Cryptochalcite* and Cesiodymite*


Cryptochalcite (IMA 2014-106), ideally K[CuO(SO4)], and cesiodymite (IMA 2016-002), ideally CsKCu4O(SO4), both triclinic, were discovered in the fumarole sublimes of the Second scoria cone, Northern Breakthrough of the Great Tolbachik Fissure Eruption, Tolbachik volcano, Kamchatka, Russia. Cryptochalcite was found in the Arsenatnaya (holotype) and Yadovitaya fumaroles, and cesiodymite was found only in the Arsenatnaya fumarole. The name cryptochalcite (Cyrillic: криптохалкит) is derived from the Greek κρυπτός, which means “concealed”, and χαλκός, which means “copper”. Cryptochalcite is a green copper mineral and occurs in intimate association with other green copper oxysulfates and is visually very similar to them, hence the name cryptochalcite means “concealed among other copper minerals.” The name cesiodymite (Cyrillic: цезиодимит) is derived from cesium (Cs) and οὐδέ·μιτος (ou doumitos) which means “a twin brother”: the mineral contains cesium and is a Cs-K-ordered analog of cryptochalcite. In the Arsenatnaya fumarole, cryptochalcite and cesiodymite belong to the same mineral assemblage and are found in association with euchlorine, chalcocyanite, dolerophanite, alumoklyuchevskite, anglesite, fedotovite, wulfite, langbeinite, piypite, klyuchevskite, chlorocyanite, dolerophanite, alumoklyuchevskite, anglesite, chalcocyanite, and cesiodymite, which cover the basalt scoria. In Yadovitaya, cryptochalcite occurs as crude, roundish, usually blocky, prismatic crystals up to 0.08 × 0.2 mm in size and forming discontinuous crusts up to 1.5 × 2 cm in area and up to 0.2 mm in thickness, also covering the basalt scoria. The two new minerals are visually not distinguishable from one another. They are both transparent, and in aggregates sometimes translucent, light green to green in color, occasionally with a yellow hue. But they both have a pale green streak, vitreous luster, and are brittle with an uneven fracture, and do not display any cleavage or parting. Their Mohs hardness is 3. Density was not measured due to the small size of the crystals and the porous nature of aggregates. Dcalc = 3.411 g/cm3 for cryptochalcite and Dcalc = 3.593 g/cm3 for cesiodymite. The new minerals are optically biaxial (−); with α = 1.610(3), β = 1.632(4), γ = 1.643(4), 2Vcalc = 65(5)°, 2V = 70° (λ = 589 nm) for cryptochalcite; and α = 1.611(1), β = 1.627(4), γ = 1.635(4), 2Vcalc = 70°(10), 2V = 68° (λ = 589 nm) for cesiodymite. No dispersion of optical axis observed for both. Cryptochalcite and cesiodymite readily become dull and bluish for several minutes and slowly dissolve in H2O at room temperature. The Raman spectra of cryptochalcite and cesiodymite are generally similar but demonstrate some difference in wavenumbers and intensities of bands (cm−1): 1200–1050 [F2(v2)-type stretching vibrations of SO42−], 1030–950 [A1(v4) symmetric stretching vibrations of SO42−; 670–590 [F2(v2) bending vibrations of SO42−]; 500–420 [E1(v2) bending vibrations of SO42−], and 320–100 (lattice modes). The absence of bands with frequencies higher than 1200 cm−1 indicates the absence of groups with O–H, C–H, C–O, N–H, and N–O bonds in both new minerals. The averages of electron probe WDS analyses (4 for cryptochalcite and 5 for cesiodymite) are [wt% (range)]: Na2O 0.30 (0.22–0.38), K2O 9.55 (9.27–9.84), Rb2O 0.89 (0.80–1.02), Cs2O 0.90 (0.72–1.08), MgO 0.83 (0.68–1.05), CuO 33.95 (32.95–34.80), ZnO 9.14 (8.83–9.48), SO4 44.06 (43.17–44.60), total 99.62 for cryptochalcite; and K2O 5.47 (4.78–5.77), Rb2O 1.55 (1.39–1.67), Cs2O 1.08 (0.98–1.13), Cu2O 29.91 (29.08–30.62), ZnO 11.05 (10.45–11.67), SO4 40.74 (39.71–41.17), total 99.20 for cesiodymite. The empirical formulae based on O=21 pfu are: (K1.28Na0.18Rb0.11Ca0.04Sr0.02Mg0.01Zn0.19Cu0.70Mn0.17Fe0.17O2) for cryptochalcite and (K1.15Rb0.17Ca0.02Cu0.65Zn0.17Sr0.16O2) for cesiodymite, an indication of the absence of Cs in cesiodymite. The strongest lines in the powder X-ray diffraction pattern are [d A, (hkl)]: 13.9 (30), 6.95 (100), 6.22 (45), 3.93 (65), 3.76 (30), 3.39 (30), 3.19 (35), 2.50 (4) for cryptochalcite; and 6.95 (54), 3.94 (100), 3.76 (37), 3.40 (39), 3.18 (50), 3.14 (27), 3.10 (28), 2.68 (31) for cesiodymite. The crystal structures of both new minerals were solved by direct methods and refined on R1 = 5.03% and R1 = 8.98% for cryptochalcite and cesiodymite, respectively. The new minerals are both triclinic, P1, Z = 4; cryptochalcite has: a = 10.0045(3), b = 12.6663(4), c = 14.4397(5) Å, α = 102.194(3), β = 101.372(3), γ = 90.008(3), V = 1751.7 Å3 while cesiodymite: a = 10.0682(4), b = 12.7860(7), c = 14.5486(8) Å, α = 102.038(5), β = 100.847(4), γ = 89.956(4), V = 1797.5 Å3. Cryptochalcite and cesiodymite are isostructural and share a novel structure type. Their crystal structures
are based on the heteropolyhedral \(\left[\text{Cu}_2\text{O}(\text{SO}_4)\right]_2^+\) framework composed by two types of alternating \(\text{Cu}^{2+}-\text{S}-\text{O}\) polyhedral layers: \(\left[\text{Cu}_2\text{O}(\text{SO}_4)\right]_2^+\) and \(\left[\text{Cu}_2\text{O}(\text{SO}_4)\right]_2^+\), which are connected via [\text{SO}_4] tetrahedra. Cu-centered polyhedra are differently distorted octahedra, tetragonal pyramids and trigonal bipyramids. K and Ca cations occupy sites in the tunnels of the framework. Cryptochalite and cesiodite differ from one another only in the ratio and distribution of K and Cs between the A sites and in the coordination of A cations. The holotype specimens for both minerals are deposited in the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia. Yu.U.

**FEODOSIYITE**


Feodosiite (2015-063), ideally \(\text{Cu}_2\text{MgCl}_3(\text{OH})_2\cdot\text{H}_2\text{O}\) was discovered in the Glavnaya Tenoritovaya ("Major Tenorite") fumarole, Second scoria cone, Northern Breakthrough (North Breach), Great Fissure eruption, Tolbakhov volcano, Kamchatka, Russia. The new mineral was found in the moderately hot sulfate-chloride zone that occurs as a lenticular body ~1.5 m long and up to 0.2 m thick, on the northern flank of the fumarole. The gas temperature in this zone during collecting was about 100 °C. Feodosiite is closely associated with belloite, avdoninite, sylvite, carnallite, chlorothionite, and dioskouriite. Other associated minerals are eriochalite, halite, mittlereschilite, sanguite, chrystohallite, romanlor- metite, mellizinkalite, flinteite, kainite, gypsum, sellaite, and incompletely studied K-Pb-Cu chlorides; hematin, tenorite, and chalcocyanite are earlier, sublimable minerals. Feodosiite occurs as well-formed or crude, tabular or prismatic crystals up to 0.015 × 0.04 × 0.05 mm, rarely up to 0.02 × 0.1 × 0.1 mm. Some crystals display thin polyhedral twinning. Crystals form groups or crusts up to 1 mm. Interrupted incrustations up to 0.5 cm × 1 cm × 0.1 mm overgrow basalt scoria. The new mineral is bright green and transparent. It has a light green streak and vitreous luster. It is brittle, has uneven fracture and one direction of imperfect cleavage, and, Mohs hardness is ~3; \(D_{\text{max}} = 2.57\) g/cm\(^3\); \(D_{\text{calc}} = 2.56\) g/cm\(^3\). Feodosiite slowly dissolves in \(\text{H}_2\text{O}\) at room temperature. In humid air the new mineral is unstable and alters to a bluish friable aggregate in the presence of hydrous Cu and Mg chlorides after several months. The mineral is air the new mineral is unstable and alters to a bluish friable aggregate in the presence of hydrous Cu and Mg chlorides after several months. The mineral is easily decomposed into its component parts in the presence of hydrous Cu and Mg chlorides after several months.

**FLUORO-TREMOLITE**


Fluoro-tremolite, ideally \(\text{Cu}_2\text{Mg}_0.5\text{Si}_3\text{O}_8\text{F}_2\), monoclinic, is the fluorine-analogue of tremolite, the composition at the root of amphibole compositional space in all classification schemes used to date. Despite the frequent use of the term “fluortremolite” (“fluorotremolite”, “fluortremolite”) in the mineralogical literature, this was remained a named amphibole (Burke and Leake 2004) and lacked a complete mineralogical description. The structural data for fluorine-rich tremolite to date was provided by Hawthorne and Grundy (1976) for a sample with F 0.66 apfu. The structure of synthetic fluoro-tremolite was first reported by Cameron and Gibbs (1973). During systematic characterization of amphiboles that still lack a complete mineral description, fluoro-tremolite was identified in a specimen G409 provided by Franklin Mineral Museum from the skarns at the Limecrest-Southdown quarry, Sparta, New Jersey, U.S.A. This specimen is now considered as holotype and has number 7710 at the same museum. Fluoro-tremolite as new mineral species was approved by CNMNC (IMA 2016-018). Coexisting phases in the holotype are calcite, chlorodrite and pyrrhotite. Fluoro-tremolite occurs as prismatic light-greenish to colorless crystals forming gray to whitish green aggregates (the data on grain or crystal sizes, presence of inclusions, twinning are not provided). It has a gray streak and vitreous luster; the crystals are transparent and do not fluoresce under ultraviolet illumination. Density was not measured; \(D_{\text{max}} = 3.044\) g/cm\(^3\). The mineral is biaxial (+), \(\alpha = 1.5987(5), \beta = 1.6102(5), \gamma = 1.6257(5)\) (589 nm), \(2V_{\text{max}} = 85(1)\), and \(2V_{\text{calc}} = 82°\) (the data on optical orientation is not provided). The FTIR spectrum of fluoro-tremolite is rather similar to that of synthetic-fluorotremolite with 1.9 F apfu (Ishida et al. 2008).

The bands (cm\(^{-1}\); sh – shoulder) are: 3672, 3658, 3643 (OH-stretching vibrations); 1132, 1104, 1059, 1039, 1017sh, 994, 954, 918 (Si-O-stretching vibrations), 880sh (\(^{18}\)O–Lattice vibrations), 755 (Si-O-Si deformations), 720, 712 (Si-O–\(^{18}\)O deformations), 678 (O-H bending vibration); 635, 590, 539 (M-O deformation). The detail analysis of peak positions in comparison with tremolite and synthetic fluoro-tremolite is given based on their crystal structures peculiarities. The average of three electron probe WDS analyses [wt% (range)] is: \(\text{Si}_2\text{O}_5\text{O}_2\text{F}_2\text{Cl}_2\text{O}\), 55.52 (55.40–55.66), \(\text{TiO}_2\), 0.14 (0.07–0.21), \(\text{Al}_2\text{O}_3\), 1.95 (1.86–2.09), \(\text{Cr}_2\text{O}_3\), 0.02 (0–0.03), \(\text{FeO}\), 2.44 (2.37–2.51), \(\text{MgO}\), 0.03 (0–0.08), \(\text{MnO}\), 0.27 (0.22–0.28), \(\text{ZnO}\), 0.10 (0–0.29), \(\text{CO}_2\), 13.81 (13.34–13.51), \(\text{Na}_2\text{O}\), 1.10 (1.06–1.16), \(\text{K}_2\text{O}\), 0.11 (0.11–0.13), \(\text{H}_2\text{O}\), 0.91, F 2.65 (2.52–2.76), Cl 0.03 (0.02–0.04). The amount of \(\text{H}_2\text{O}\) was calculated based on single-crystal structure refinement and with the constraints of non-negative \(\text{Fe}^{3+}\) values and \((\text{OH} + \text{F} + \text{Cl}) = 2\) atoms pfu. The empirical formula is \(\text{Na}_{0.03}\text{K}_{0.02}\text{Mg}_{0.00}\text{H}_{0.03}\text{Cu}_{0.96}\text{Si}_{3.00}\text{O}_{8.00}\text{F}_{2.00}\)\(^{2+}\).
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**FLUOR-TREMOLITE**

The temperature of gases at the sampling location was ~600–620 °C, the vent of fumarole was encrusted with vitreous to glassy material. The fumarole is a new mineral discovered in the fumaroles on the eastern side of the Klyuchevskaya Sopka volcano during the 2012–2013 eruption, Kamchatka Peninsula, Russia. The strongest lines of the powder X-ray diffraction pattern are [d Å (Ps < hkl)]: 2.706 (100; 151), 6.98 (200; 004), 4.655 (37; 006), 3.555 (88; 020,311), 2.827 (100; 062,315,317, 2.055 (28; 33,602), 3.126 (67; 310), 2.531 (59; 202), 3.381 (57; 131), 2.940 (43; 151,221), 3.276 (37; 240), 2.337 (36; 251), 2.592 (35; 061), 2.731 (34; 331), 2.163 (34; 261). The crystal structure was refined to R = 1.7%. Fluoro-tremolite is monoclinic, C2/m, a = 9.846(2) Å, b = 18.050(9) Å, c = 5.2769(14) Å, β = 104.80(2)°, V = 906.7 Å³, Z = 2. The refined and analyzed crystal was assigned code 1082 in the amphibole database of the CNR-IGG in Pavia, Italy. The new structure and crystal-chemical data provided for synthetic fluoro-tremolite and tremolite from the type locality of Val Tremola (codes 751 and 361, respectively, in the same database). In the structure F is located in O(3) site, which is contributed by the cations at the M(1) and M(3) sites. Cameron and Gibbs (1973) showed that the OH–F substitution significantly reduces the size of octahedral strip and hence the a and b cell parameters. The higher thermal stability of fluoro-tremolite was explained by both the higher bond-strength of the Mg–F bonds compared to Fe–F bonds. In fluoro-tremolite 1082 the significant contraction observed for the M(1)–O(2) and M(3)–O(1) bond distances although the O(1) and O(2) sites are not involved in the OH–F exchange. This shortening must be related to a general contraction of the O-layer due to the presence of F at the O(3) site. The A cations preferentially order at the A(m) subsite.

**Comments:**

Fluor-tremolite is most likely a common mineral than it thought to be since in a number of an older analysis of tremolite fluorine was not measured. “Fluortremolite” with F 3.84 wt% (1.64 apfu) described by Petersen et. al. (1982) from Adirondack marbles (near Balmat, New York, U.S.A.). But no complete description was submitted to CNMNC IMA. The distribution of fluoro-tremolite in nature deserves an additional study. Cameron and Gibbs (1973) showed that the (OH)–F substitu

**References cited**


**ITELMENITE**


Itelmite (IMA 2015-047), ideally Na₂CuMg₃(SO₄)₄, orthorhombic, was discovered in 2014 in Saranchinaitoavaya fumarole on the Naboko scoria cone (N55°46′06″, E160°18′59″, altitude 1650 m) of the Tolbachik volcano Fissure Eruption (2012–2013), Kamchatka Peninsula, Russia. The temperature of gases at the sampling location was ~600–620 °C. Itelmite could be deposited directly from the gas or might form as a result of the interaction between gas and basalt scoria. Itelmite occurs as irregularly shaped grains or microcrystalline masses associating with anhydrite, saranchinite, hermannjakhte, euchlorine, thénardite, aphythite, and hematite. Itelmite is light grayish-blue with a white streak and a vitreous luster. It is brittle with uneven fracture and no cleavage. Hardness and density were not measured due to the lack of suitable material; Dcalc = 3.10 g/cm³. The estimated Mohs hardness is 2–3. The mineral is unstable in air, is soluble in H₂O at room temperature and slowly transforms into a hydrate in humid air. In transmitted plane-polarized light itelmite is colorless, nonpleochroic. It is optically biaxial (+), α = 1.535(2), β = 1.555(2), γ = 1.585(2) (589 nm), 2Vcalc = 79.8°. The average of 10 spots electron-probe EDS analysis (using defocused 5 μm beam) is [wt% (range)]: Na₂O 10.77 (9.97–11.23), K₂O 0.20 (0–0.31), MgO 11.10 (9.10–11.75), CuO 15.38 (14.78–15.71), ZnO 5.61 (4.15–6.05), SO₃ 56.42 (55.20–57.02), total 99.48. No other elements with Z > 9 were detected. The empirical formula based on O = 32 pfu is (Na1.93K0.07)Σ2.00 Mg₀.₀₉Cu₀.₉₃Zn₀.₉₃Mg₀.₉₃Σ₃O₁₀.₈₈(Σ2.00)

**OZEROVAITE**


Ozeraite (IMA 2016-019), ideally Na₂KAl₃(AsO₄)₆, orthorhombic, is a new mineral discovered in the fumaroles on the eastern side of the microgranob of the second cinder cone of the Great Tolbachik Fissure Eruption, Tolbachik volcano, Kamchatka Peninsula, Russia. The temperature of the volcanic gases in the fumarole at time of sampling (1983) was about 410–420 °C. The vent of fumarole was encrusted with nonomarevite, while pyrite prevailed at a depth of 0.5 m. The bottom of the visible part of the fumarole was encrusted with sylvinite associating with dolerite (2012–2013), lammerite, johannite, uraruite, bradaczekite, filatovite, hetatrite, hematite, ozerovate, wrightite, and tenorite. Based on association, the formation temperature of the arsenate minerals is estimated as 500–600 °C. Ozeroite forms tabular crystals of 0.04 × 0.02 × 0.004 mm average size in aggregates of 0.02–0.3 mm. Crystals are colorless to pale yellow, transparent, with white streak, vitreous luster, and good cleavage on {010}. The mineral is brittle. Hardness and density
were not determined, due to the small crystal size; \( D_{\text{calc}} = 3.439 \text{ g/cm}^3 \). The mineral is insoluble in water. It is colorless in transmitted plane-polarized light. Ozerovite is optically biaxial (–), \( a = 1.645, b = 1.667(2), c = 1.674(2) \) (589 nm), \( 2V_{\text{calc}} = 58(10)^\circ \). The average of four electron probe EDS analyses is [wt% (range)]: NaO 7.71 (7.54–7.96), K O 6.91 (6.59–7.34), As O 61.8 (60.68–62.59), P O 2 0.70 (0.66–0.75), Cu O 1.18 (1.02–1.42), Al O 18.23 (17.88–18.67), Fe O 3.48 (3.24–4.05), Zn O 0.37 (0.31–0.42), total 100.04. No other elements were detected. The empirical formula based on 16 O pfu is \([\text{Na}_{(0.31–0.42)}\text{Fe}_{(0.66–0.75)}\text{Cu}_{(6.59–7.34)}\text{Zn}_{0.02}\text{Al}_{18.23}\text{As}_{1.18}\text{P}_{0.70}]\). The strongest lines of the X-ray powder diffraction pattern are \([d A (\text{P}, \text{hkl})]: 10.37 (44; 020), 5.47 (47; 200), 4.84 (47; 220), 3.76 (17; 240), 3.07 (26; 061), 2.922 (83; 260), 2.824 (100; 202), 2.735 (71; 400). The unit-cell parameters refined from the powder data are \( a = 10.588(14), b = 20.94(2), c = 6.384(8) \) Å, \( V = 1415 \text{ Å}^3 \). Single-crystal X-ray data shows ozerovite is orthorhombic: \( \text{Ccna}, a = 10.615(2), b = 20.937(3), c = 6.393(1) \) Å, \( V = 1420.9 \text{ Å}^3, Z = 4 \). The crystal structure refined to \( R = 0.031 \) based on 946 unique observed reflections. It is constructed of \( \text{AlO}_6 \) octahedra and strongly distorted \( \text{AsO}_4 \) tetrahedra, linked by the corners and edges. Adjacent layers, parallel to (010), are held together by \( \text{K}_2 \), \( \text{Na}_2 \), and \( \text{NaO}_2 \) polyhedra. There are two \( \text{AsO}_4 \) tetrahedra and two \( \text{AlO}_6 \) octahedra in one asymmetric unit. Each \( \text{Al}(1) \text{O}_6 \) octahedron is connected by the corners with four \( \text{Al}(2) \text{O}_6 \) octahedra and six \( \text{AsO}_4 \) tetrahedra, whereas an \( \text{Al}(2) \text{O}_6 \) octahedron shares a common edge with an \( \text{As}(2) \text{O}_4 \) tetrahedron, and shares corners with four other \( \text{AsO}_4 \) tetrahedra and two \( \text{Al}(1) \text{O}_6 \) octahedra. The crystal structure of ozerovite is related to that of the \( A_B X(\text{XO}_4) \) family, \( (A = \text{Na}, \text{K}, \text{Sr}; B = \text{Al}, \text{Cr}, \text{Fe}; X = \text{As}, \text{P}) \) and is similar to synthetic Na-K-Al\((\text{AsO}_4)\). The mineral name honors Nina Aleksandrovna Ozerova (1930–2012), for her contributions to geochemistry, geology, metallogeny, ecology and the eco-geochemistry of mercury. The type material is deposited at the Mineralogical Museum, St. Petersburg State University, St. Petersburg, Russia. D.B.

RAMAZZOITE*
A.R. Kampf, G.R. Rossman, C. Ma, D. Belmonte, C. Biagioni, F. Castellaro and L. Chiappino (2018) Ramazzoite, \([\text{Mg}_{(2)}\text{Cu}_{(12)}\text{P}_{(3)}\text{O}_{(8)}\text{CO}_{(4)}\text{(OH)}_{(4)}\text{(H}_2\text{O})_{(24)}]([\text{H}_{(3)}\text{Zn}_{(10)}\text{SO}_{(4)}\text{(H}_2\text{O})_{(16)}], the first mineral with a polyoxometalate cation. European Journal of Mineralogy, 30(4), 827–834.

Ramazzoite (IMA 2017-090), \([\text{Mg}_{(2)}\text{Cu}_{(12)}\text{P}_{(3)}\text{O}_{(8)}\text{CO}_{(4)}\text{(OH)}_{(4)}\text{(H}_2\text{O})_{(24)}]([\text{H}_{(3)}\text{Zn}_{(10)}\text{SO}_{(4)}\text{(H}_2\text{O})_{(16)}], cubic, is a new polyoxometalate (POM) mineral from the Monte Ramazzo mine (44°28′5″S, 8°51′35″E), near Genova, Liguria, Italy. The mine was operating at least as early as 1465, mainly for copper, and later for iron sulfate and magnesium sulfate. The ore is hosted in ultramafic rocks (serpentinites) in contact with mafic rocks (basalt dikes and pillow lavas) of the Figogna Unit in the Ligurian Alps. Ramazzoite is a late-stage, secondary mineral that crystallized from low-temperature, aqueous solution. Ramazzoite is found on magnetite-rich maﬁtes; associated minerals include chlorarhinite, chrysotile, dypingite, goethite, lepidocrocite, nesquehonite, and an unidentified Mg sulfate-carbonate. Ramazzoite occurs as simple cubes up to about 0.15 mm on edge. Crystals are blue to greenish blue and transparent with a vitreous to oily luster and pale blue streak. Twins by merohedry were observed during structure determination. Crystals are very brittle with a conchoidal fracture. Perfect cleavage was observed on \{100\}. Mohs hardness is 2½ (scratch test). The mineral is non-fluorescent. \( D_{\text{calc}} = 1.98 \text{ g/cm}^3 \) (by floatation in methylene iodide-toluene) and \( D_{\text{obs}} = 1.962 \text{ g/cm}^3 \). It is isotropic with \( n = 1.493(1) \) (white light). The single-crystal X-ray diffraction mineral name of ramazzoite is \( \text{Ramazzoite} \). The mineral name is deposited in the Natural History Museum of Los Angeles County, Los Angeles, California, U.S.A., catalogue numbers 66691 and 66692. F.C.

REDCANYONITE*
T.A. Olds, J. Pläśl, A.R. Kampf, P.C. Burns, B.P. Nash, J. Marty, T.P. Rose and S.M. Carlson (2018) Redcanyonite, \([\text{Ni}_{(2)}\text{Mn}_{(12)}\text{UO}_{(4)}\text{O}_{(4)}\text{SO}_{(4)}\text{(H}_2\text{O})_{(24)}]([\text{H}_{(3)}\text{Zn}_{(10)}\text{SO}_{(4)}\text{(H}_2\text{O})_{(16)}], a new zippel-group mineral from the Blue Lizard mine, San Juan County, Utah, USA. Mineralogical Magazine, 82(6), 1261–1275.

Redcanyonite (IMA 2016-082), \([\text{Ni}_{(2)}\text{Mn}_{(12)}\text{UO}_{(4)}\text{O}_{(4)}\text{SO}_{(4)}\text{(H}_2\text{O})_{(24)}]([\text{H}_{(3)}\text{Zn}_{(10)}\text{SO}_{(4)}\text{(H}_2\text{O})_{(16)}], monoclinic, is a new member of the zippel group, which occurs underground in the Blue Lizard mine, on the northern edge of the Red Canyon, White Canyon district, San Juan County, Utah, U.S.A. (37°33′26″N, 110°17′44″W). Secondary uranium mineralization in Red Canyon is often localized and most prevalent within organic-rich beds that are laced with uraninite and sulfides. The source of \( \text{NH}_4 \) is inferred from decomposition of organic material. Redcanyonite occurs intimately with ammoniozippeite in several specimens. Other associated secondary minerals include bohooite, brochantite, devilline, gypsum, johannite, posnjakite, natrozippeite, palevittlakite, and pickeringite. Redcanyonite occurs as radial aggregates (up to 1 mm in diameter) of needles and blades individually measuring up to 0.2 mm long. Crystals are flattened on \{010\} and elongated on \{100\}, and exhibit the forms \{001\}, \{101\}, \{101\}, and \{101\}. Many crystals are twinned by 180° rotation on \{100\}. Crystals are translucent with a vitreous luster, pale orange streak, and are non-fluorescent under both long-wave and short-wave ultraviolet illumination. Mohs hardness is ~2. Crystals of redcanyonite are brittle with perfect \{010\} cleavage and uneven fracture. The density was not measured due to the lack of material; \( D_{\text{calc}} = 4.633 \text{ g/cm}^3 \) (based on the empirical formula) and 4.688 g/cm³ (for the ideal formula). Optimally

American Mineralogist, vol. 104, 2019

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is biaxial (+), with \( \alpha = 1.725(3), \beta = 1.755(3), \) and \( \gamma = 1.850(5) \) (white light); \( 2V_{\text{meas}} = 60(2)^\circ, 2V_{\text{calc}} = 61.3^\circ; X = b, Y = c, Z = a. \) Dispersion of an optical axes is very strong, \( r < v. \) The mineral is pleochroic with \( X = \text{orange}, Y = \text{yellow} \) and \( Z = \text{orange}; Y < X < Z. \) Attenuated total reflectance (ATR) Fourier-transform infrared (FTIR) shows the following bands (cm\(^{-1}\): \( v_s \) – verystrong, \( s \) – strong, \( w \) – weak, \( sh \) – shoulder): broad between \(-3500 \) and \(-2800 \) \( (\nu \text{O-H stretching vibrations of hydrogen}

rich maliginate of the Lovozero alkaline massif (Kola Peninsula, Russia). European Journal of Mineralogy, 30(3), 525–535.

Selivanovaite (IMA 2015-126), \( \text{Na}_{10} \text{Fe}_{2+} \text{Cl}_{16} \text{Si}_{32} \text{O}_{104} \text{Cl} \), triclinic, is a new tinitosilicate of the murmanite group (seidozerite–stengroup) found in drill cores of medium-grained trachytyd eudeyulate maliginate of M. Kedkvykkpakhk, at the horizon 850–1050 m (50–150 m below day surface) (Allhuav set of the giant Lovozero loparite–eudeyulate Tn-Nb-REE-Zr deposit). The rock consists mainly of euhedral microcline-perthite (up to 1.5 cm), nepheline (up to 1 cm) and manganoeudialyte crystals (up to 0.5 cm) cemented by fine-acicular aegirine with poikilitic laths of minor lamprophyllite and selivanovaite (up to 10 %; 3% in average). The mean modal composition of the rock is \( \text{K}_2 \text{FeSi}_2 \text{O}_8 \text{Al}_2 \text{Fe}_2 \text{Ti}_2 \text{O}_8 \cdot 19 \text{H}_2 \text{O} \). Other minor rock-forming minerals include sodalite, natrolite, and magnesioarfovedsonite. Characteristic accessory minerals are murmanite, loparite–(Ce), pyrochlore, thorite, anatase, baryte, rhabdophane–(Ce), pyhrotite, chalcopyrite, pyrite, chlorbartonite, djerfisherite, sphalerite, and löllingite. Selivanovaite forms dark-orange vitreous to greyish anehal platy metacrysts up to 8 mm with numerous poikilitic inclusions of aegirine and magnesioarfovedsonite. It is translucent in thin plates and has a brownish-white streak. The cleavage is perfect on \( 001 \) and weak on \( 110 \), the fracture is stepped. The mineral is brittle with Mohs hardness \(-3. D_{\text{meas}} = 3.15(3) \) (Clerici solution); \( D_{\text{calc}} = 3.34(3) \) g/cm\(^3\). Selivanovaite dissolves slowly in 10% cold HCl. In transmitted light, selivanovaite is brown and non-pleochroic. It is biaxial (\( + \)), \( \alpha = 1.79(1), \beta = 1.81(1), \gamma = 1.87(1) \) \( (589 \) nm), \( 2V_{\text{calc}} = 40(5)^\circ, 2V_{\text{meas}} = 57.3^\circ; Z^* = 5–10^\circ; \) dispersion of optical axes was not observed. The Raman spectrum of selivanovaite (the mineral is very unstable under the laser beam) shows bands (cm\(^{-1}\)): 1600 (symmetric bending vibrations of SiO\(_2\)) in region between 690 and 434 (symmetric and antisymmetric bending vibrations of SiO\(_2\)); 780, 930 (Si–O stretching); 610, 281, 180 (symmetric stretching and bending vibrations of the TiO\(_4\), FeO\(_4\), and MgO groups); 77, 104, 147 – lattice modes. The average of WDS electron probe analysis (5–6 points on each of 3 crystals with defocused beam moved during the analysis to avoid water loss due to instability the mineral under the beam) \( \omega \% \) (range) is: \( \text{Na}_2 \text{O} 5.45 (4.06–7.17), \) \( \text{MgO} 0.59 (0.41–0.70), \) \( \text{Al}_2 \text{O}_3 0.04 (0.01–0.11), \) \( \text{SiO}_2 25.55 (23.38–27.83), \) \( \text{K}_2 \text{O} 0.63 (0.17–1.28), \) \( \text{CaO} 1.68 (1.35–2.34), \) \( \text{TiO}_2 31.17 (26.77–36.95), \) \( \text{MnO} 2.46 (2.29–2.89), \) \( \text{FeO} 6.63 (3.10–10.94), \) \( \text{ZrO}_2 2.31 (2.01–7.21), \) \( \text{Nb}_2 \text{O}_5 6.69 (6.04–7.02), \) \( \text{H}_2 \text{O} 17.0 \) **(by the Penfield method),** total 100.38. The empirical formula calculated on the basis of Si = 4 pfu is: (Na\(_{10}\)Fe\(_2+\)Cl\(_{16}\)Si\(_{32}\)O\(_{104}\)Cl)·23.3H\(_2\)O. The Raman spectrum of selivanovaite shows the presence of a significant amount of nonstructural (adsorbed) water up to 1 cm), moreover, similar to murmanite, the non-structural H\(_2\)O can be easily eliminated in vacuum or under even mild heating. There are no clear relations between different cation contents, but the mineral enriched with Fe at the expense of Ti and Na compared to coexisting murmanite due to the isomorphic substitutions 2Na\(^+\) + Ti\(^4+\) → 2Fe\(^3+\) and/or Na\(^+\) + Ti\(^4+\) → Ca\(^2+\) + Fe\(^3+\). The strongest X-ray powder-diffraction lines [\( d_A \) (\( hkl \)) \( = 11.43 (100; 001), 6.37 (25; 111), 5.73 (15; 002), 4.208 (16; 211), 3.108 (35; 221), 3.043 (20; T04), 2.596 (17; 014). Unit-cell parameters refined from the powder patterns are: \( a = 8.673(5), b = 8.694(1), c = 12.21(1)^\circ, \) \( \alpha = 92.70(5), \beta = 108.52(1), \gamma = 105.42(1)^\circ, V = 833 \text{ Å}^3, Z = 2. \) The single-crystal cell parameters are practically identical: \( a = 8.673(5), b = 8.694(3), c = 12.21(1)^\circ, \) \( \alpha = 92.70(5), \beta = 108.46(7), \gamma = 105.40(4)^\circ. \) The single-crystal X-ray data for a crystal 0.015 × 0.015 × 0.02 mm shows extremely weak diffraction. The structure was refined using the program SHELXL using single-crystal X-ray diffraction on a crystal of \( 0.030 \text{ mm shows}\).
NEW MINERAL NAMES

VANDERHEYDENITE*


Vanderheydenite (IMA 2014-076), ideally Zn₂(PO₄)₂(SO₄)(OH)₄·7H₂O, monoclinc, is a new mineral from the Block 14 Opencut, Broken Hill, New South Wales, Australia. The Broken Hill ore body consists of massive, recrystallized sphalerite- and galena-rich sulfide hosted within a unit of gneiss known as the Potosi Gneiss. The lower portion of the oxidized zone grades into silver-rich supergene mineralization, comprising coronadite, quartz, kaolinite, and goethite. Between this and the sulfide zone is an irregular zone of cerasite, whose boundary with the sulfide zone is marked by a band of leached sulfides, where vanderheydenite was found in a highly weathered sulfide ore in the Block 14 Opencut. The new mineral formed in cavities as a result of the release of Zn, S, As, and P from the breakdown of sphalerite, galena, and fluorapatite. Associated minerals are colorless to white prisms of pyromorphite, colorless crystals of anglesite, and aggregates of colorless to white crystals of liversidite. Vanderheydenite occurs as aggregates of colorless crystals up to 0.5 mm across. Individual crystals are thin blades that are flattened on {100} and are up to 0.4 mm in width and 0.05 mm in thickness. Crystal forms are major {101}, {100}, and {021}, resulting in a pseudohexagonal outline. Vanderheydenite has a white streak and a vitreous luster; it does not fluoresce under ultraviolet light. Mohs hardness is ~3. Cleavage or parting are not reported. Hardness and density were not determined due to the small crystal size; D₄₄ = 3.50 g/cm³. Vanderheydenite is orthorhombic, space group Pnma, unit-cell parameters, derived from a powder XRD data are: a = 8.2377 (3), b = 17.584 (1) Å, c = 803.9 Å. The crystal structure consists of two independent isolated AsO₄ tetrahedra, overlapping with v₁, vibration of the PO₄ tetrahedra, 968 (v₁, vibration of the SO₄ tetrahedra, overlapping with v₁, vibration of the PO₄ tetrahedra of SO₄²⁻ ions), 885 and 853 (v₁, vibration of the AsO₄ tetrahedra). The average of 13 WDS electron probe analyses is [Zn]: 53.65 (54.49–56.68), CuO: 0.07 (0.00–0.21), Fe₂O₃: 0.11 (0–0.28), MnO: 0.06 (0-0.15), P₂O₅: 14.18 (13.10–15.29), As₂O₅: 4.33 (3.15–5.18), SO₄: 8.71 (7.31–9.85), H₂O: 18.31 (from the structural formula), total 101.40. The empirical formula was calculated on the basis of 23 oxygen atoms is (Zn₁₉.₅₋ₓCuₓFeₓ₁₋ₓO₁₉.₅₋ₓCuₓFeₓ₁₋ₓP₁₉.₅₋ₓCuₓFeₓ₁₋ₓAs₁₉.₅₋ₓCuₓFeₓ₁₋ₓ)[PO₄]₉₀.₅₋ₓCuₓFeₓ₁₋ₓ[(AsO₄)₀.₅₋ₓ(PO₄)₀.₅₋ₓ·7H₂O], 69.68H₂O. The strongest lines of the powder X-ray diffraction pattern [d (hkl)] are: 9.826 (57; 020), 7.296 (20; 1011), 6.134 (100; 021), 3.368 (10; 032,150), 3.069 (9; 210,042). The unit-cell parameters calculated from the powder data are: a = 6.209 (2), b = 19.637 (7), c = 7.822 (3) Å, β = 90.672 (2)°, V = 953.64 Å³. The crystal structure was solved by direct methods using single crystal X-ray diffraction on a crystal of 0.070 x 0.050 x 0.005 mm (R₁ = 0.0497 for 939 Fₜ - 4σFₜ reflections; Rₑ = 0.1228 for 1920 reflections). Vanderheydenite is monoclinic, P₂₁/n, a = 6.2040 (12), b = 19.619 (4), c = 7.7821 (16) Å, β = 90.67(3)°, V = 947.1 Å³, Z = 2. The crystal structure of vanderheydenite is unique and is comprised of zigzag sheets of Zn₉O₉ octahedra, Zn₆O₉ trigonal bipyramids and TO₄ tetrahedra. Alternate Zn₁₉₀₈, (w = O, OH, or H₂O) and Zn₉O₉ octahedra share trans edges to form a [M₈] chain that extends parallel to [100]. The Zn₆O₉ trigonal bipyramids share an edge with both Zn₁₉₀₈ and Zn₂₉₈ octahedra and link to a second [M₈] chain by corner sharing, forming zigzag sheets in the (010) plane. Sheets are decorated by corner-sharing TiO₄ tetrahedra. Sheets link in the [011] direction by TiO₄ tetrahedra which share corners with Zn₁₉₀₈ and Zn₂₉₈ octahedra. Intersitial channels between the sheets extend parallel to the a-direction and are occupied by H₂O groups, which are strongly to weakly hydrogen bonded. The mineral is named in honor of Arnold van der Heyden who worked as a mine geologist at Broken Hill for the former Minerals Mining and Metallurgy Ltd from December 1985 until June 1991. The holotype specimen (also the holotype specimen for liversidite, Zn₂(PO₄)₂·7H₂O) is deposited in the South Australian Museum, Adelaide, South Australia. F.C.

WRIGHTITE*


Wrightite (IMA 2015-120), ideally K₄AlO₃(AsO₄)₃, orthorhombic, is a new mineral discovered in 1983 in one of fumarole on the east side of the microgranen at the Second scoria cone, Northern Breakthrough, Great Fissure eruption, Tolbachik volcano, Kamchatka peninsula, Russia. The temperature of the volcanic gases in the fumarole was 410–420 °C and the vent was encrusted with ponomarevite, while pipyite prevailed at a depth of 0.5 m. The bottom of the visible part of the fumarole was encrusted with sulfitite associating with dolerophanite, euchlorine, lumarite, johillerite, ussuriotite, kristolvite, hatertite, hematite, ozerovite, and tenorite. Based on association, the formation temperature of the arsenate minerals is estimated at 500–600 °C. Wrightite forms light yellow aggregates of transparent tabular colorless to light yellow crystals, with an average size 0.05 × 0.03 × 0.005 mm. Well-formed crystals are very rare. The mineral has vitreous luster and white streak. It is brittle. Cleavage or parting are not reported. Hardness and density were not determined due to the small crystal size; D₄₄ = 3.50 g/cm³. Wrightite is orthorhombic, space group Pnma, unit-cell parameters, derived from a powder X-ray diffraction pattern [d (Pnma, hkl)] are: 8.77 (36; 002), 6.01 (18; 102), 4.458 (17; 111), 4.097 (16; 112), 4.010 (19; 201,013), 3.875 (19; 104), 3.003 (16; 204); 2.972 (100; 015). The unit-cell parameters, derived from a powder XRD data are: a = 8.2305(5), b = 5.555(4), c = 17.584(1) Å, V = 803.9 Å³. Single-crystal X-ray data shows Wrightite is orthorhombic, space group Pnma, a = 8.2377(3), b = 5.5731(6), c = 17.683(1) Å, V = 811.8 Å³, Z = 4. The crystal structure (refined to R₁ = 0.043 for the 1924 independent reflections) is similar to that of the synthetic analog Na₄K₄AlO₃(AsO₄)₃ and consists of AlO₃(AsO₄)₃ layers in the (001) plane with clusters of edge-sharing AlO₆ octahedra. Each layer contains two independent isolated AsO₄ tetrahedra and two AlO₆ octahedra. AlO₆ octahedra are linked by edges, forming zigzag chains along the b axis inside the AlO₃(AsO₄)₃ layer. Eightfold- and sixfold-coordinated K atoms are located in the interlayer space between AlO₃(AsO₄)₃ layers. The mineral name honors Adrian Carl Wright (b. 1944), Emeritus Professor at the University of Reading, U.K., a well-known expert in structural studies of glass-forming systems. The type material is deposited at the Mineralogical Museum, St. Petersburg State University, St. Petersburg, Russia. D.B.